MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2016/2017

EOP3056 – OPTICAL METROLOGY AND TESTING

(All sections / Groups)

8 MARCH 2017
9.00 a.m - 11.00 a.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 4 pages with 4 Questions only.

2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please print all your answers in the Answer Booklet provided.

Question 1

(a) Given a mono-chromatic light source as:

$$E(x,y,z,t) = Re\{ae^{-i\theta}e^{i\omega t}\}, \qquad \text{Eq. Q1}$$

where $\theta = 2\pi z / \lambda$. Describe I, the interfered power outcome from 2 identical E interference.

[10 marks]

(b) In Three (3D) Dimensional analysis, there are numerous approach to assist human in qualitative evaluation. Suggest 3 common techniques and explain briefly the principle of working. List down their advantages and disadvantages.

[15 marks]

Question 2

As an engineer in measurement, you are required to prepare and give recommendation to the client in the optical setup of a screw manufacturer.

(c) Suggest 4 methods for the quality assurance of the screw using optical metrology technique. Highlight the strength and weakness of each technique accordingly.

[12 marks]

(d) Use a diagram of Michelson interferometer, explain how is the quality of the screw threading can be tested and the pitch of the thread can be measured accurately.

[8 marks]

(e) If it is a Michelson interferometer setup, one of its mirrors are mounted on the testing rig. The laser used is 632.8 nm. It is observed to have 1581 fringes cross a reference mark in the field. What is the pitch of the screw?

[5 marks]

Continued .....

Question 3

a. Using a diagram, explain how an active system of your choice (give the name of the system) that can be used to measure 3D range data.

[13 marks]

b. Suppose the system suggested in Q3 (a) indicated a relationship between the expected range data (3D) as $\vec{Y}$ with the range of measured vector $\vec{x}$.

$$\vec{Y} = A\vec{x}$$

where A is the transformation matrix. Suggest a technique to estimate vector $\vec{Y}$.

[5 marks]

c. Using a diagram, explain electronic speckle pattern interferometry.

[7 marks]

Question 4

a. In optical mirror testing, an engineer uses Twyman-Green interfergrams as the evaluation of mirror surface. He obtains 4 results as Fig Q4 below.

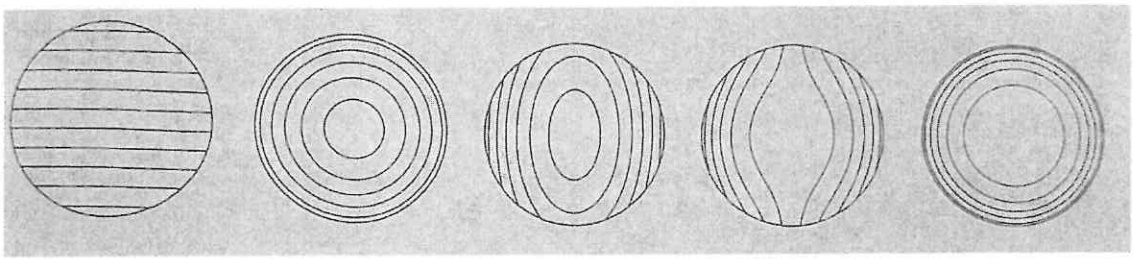

Fig. Q4

Use your own words, explain the surface abnormally accordingly. Suggest an improvement or adjustment to the mirror surface to improve each abnormally.

[10 marks]

Continued .....

Question 4 (continued)

b. Given 2 circular glass plate (n = 1.53) with a diameter of 100mm are polished flat and nominally parallel. The plate is examined in a Fizeau interferometer from which the reference flat surface has been removed. With an He-Ne laser as the source (633nm), straight, parallel interference fringes with a spacing of 12.5mm are seen. What is the angle between the faces of the plate?

[8 marks]

c. If this plate is introduced in one beam of a Twyman-Green interferometer adjusted to produce a uniform field, what would be the separation of the fringes?

[7 marks]

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